Ministry of
Transportation and
Communications

Ontario

MI-100

EFFECTIVENESS OF PENETRATING SEALANTS ON CONCRETE ALREADY CONTAMINATED BY SALT & DAMAGED BY SALT SCALING

MATERIALS INFORMATION
ENGINEERING MATERIALS OFFICE

memorandum

248-3684

Ontario

To: Mr. R. P. Northwood
Head, Concrete Section

Date: 86 10 14

File: 4201-11

From: Concrete Section
Engineering Materials Office
Room 111, Central Building
Downsview

Re: Effectiveness of Penetrating Sealants on Concrete Already Contaminated by Salt and Damaged by Salt Scaling

---

A Laboratory Evaluation of Concrete Surface Sealants (Report MI-79) and a subsequent evaluation of concrete surface sealants for concrete barrier walls, Burlington Bay Skyway, Cont. 83-13, identified both Nitocote Dekguard and Nitocote SN 502 (manufactured by Fosroc) as performing excellently in salt scaling tests. Both investigations were conducted on new concrete slabs that had not undergone any prior salt scaling.

Following are the results of an investigation to evaluate the effectiveness of Nitocote Dekguard and Nitocote SN 502 on concrete already contaminated by salt and having undergone previous salt scaling. Initially, concrete scaling slabs were selected that had shown a significant scaling loss in the standard 50 cycles of testing. Slabs manufactured with concrete containing 100% Type 10 cement, 75% Type 10/25% GGBFS and 75% Type 10/25% Fly Ash C were selected. For each pair of slabs, one slab was selected as control and the second was sandblasted and treated with the penetrating sealant. Each slab was then subjected to salt scaling tests using 3% sodium chloride solution for an additional 50 cycles of freeze/thaw. Upon completion of the standard testing, the slabs treated with the sealants were subjected to an additional 50 cycles to compare the relative performance of both sealants.

In addition, a pair of slabs manufactured with non air-entrained concrete that had rendered massive scaling losses after only 25 cycles of testing was also evaluated. Both slabs were treated (one with Dekguard and the other with SN 502) and subjected to salt scaling tests for an additional 50 cycles.

Finally, two sets of new scaling slabs were manufactured. One slab from each set was selected as control and the remaining slab(s) were interrupted after a brief period of salt scaling cycles and subsequently treated with Dekguard and/or SN 502.

Results of the salt scaling tests are shown in Table 'A'.

Discussion of Results

1. In general, both sealants were effective in reducing the salt scaling of slabs already damaged by previous salt scaling.

2. In all cases, both sealants (Nitocote Dekguard and Nitocote SN 502) performed equally relative to one another even after an extended 100 cycles.

3. The effectiveness of the sealants on non air-entrained concrete was limited to 25 cycles.

4. On concretes that had received an initial brief exposure to salt scaling, the sealants began to lose their effectiveness after 35-40 cycles. In the case of the concrete made with 100% Type 10 cement, the slabs treated with the sealants had greater scaling loss after 50 cycles than the control.

5. Amongst the slabs of normal air-entrained concrete that had undergone prior extensive scaling, there was no significant difference in the performance between any of the slabs treated with sealants, regardless of the type of cementing material or aggregate employed. Both sealants significantly reduced salt scaling relative to the control slabs. There was, however, a noticeable difference in the performance of the different control slabs.

Conclusions

The serviceability of the penetrating sealants tested is significantly reduced when they are applied to either normally air-entrained concrete shortly after initial signs of salt scaling have commenced or to non air-entrained concrete at various degrees of prior scaling. Maximum serviceability is achieved when the sealants are applied to new concrete surfaces that have not been previously exposed to deicing salts. It can be assumed that surfaces exposed to prior salt scaling would require more frequent re-application of the sealant to maintain satisfactory performance.

Recommendations

On the basis of the equivalent performance between the Nitocote Dekguard and Nitocote SN 502 in the salt scaling tests, the SN 502 being less expensive in both material and labour is recommended to be used in the field when specified for controlling potential salt scaling. However, where consideration to controlling carbonation of concrete or chloride ion penetration as well as salt scaling is important, Dekguard is recommended.

R. Newell
Concrete Engineer

RN/mc
Attachment

TABLE A
SALT SCALING TEST RESULTS

CONCRETE MIX DESIGN	AIR CONTENT % (FRESH CONC.)	INITIAL SALT SCALING TESTS (NO SEALANT) PREVIOUS CUM. MASS LOSS kg/m^2	INITIAL SALT SCALING TESTS (NO SEALANT) NO. OF CYCLES	SEALANT	SALT SCALING TESTS AFTER SEALANT APPLIED (CUMULATIVE MASS LOSS (g/m^2) AFTER INDICATED NUMBER OF CYCLES) STANDARD 50 CYCLES 5	10	15	20	25	30	35	40	45	50	EXTENDED CYCLES 55	60	65	70	75	80	85	90	95	100
20MPa	6.5	4.0	50	CONTROL	100	286	401	430	474	517	554	608	616	650										
100% TYPE10		2.0	50	DEKGAURD	30	34	40	49	57	59	76	86	96	129	144	175	188	265	311	354	383	432	569	603
20MPa	6.8	2.9	50	CONTROL	89	306	447	480	553	579	615	654	671	709										
100% TYPE10		2.7	50	SN 502	3	5	7	9	12	20	24	32	39	56	67	84	108	143	179	209	229	290	*	
20MPa	1.8	10.2	25	DEKGUARD	5	5	10	10	10	327	473	840	1349	1838										
100% TYPE10	2.5	10.7	25	SN 502	7	12	45	67	135	368	885	1085	1646	2512										
20MPa																								
75% TYPE10	6.6	1.5	50	CONTROL	36	165	287	313	338	381	412	454	471	488										
25% GGBFS		1.6	50	DRKGUARD	0	0	12	24	24	27	34	60	77	91	104	121	178	239	273	297	316	345	*	
20MPa																								
75% TYPE10	6.5	1.4	50	CONTROL	20	26	46	53	58	66	70	78	83	100										
25% GGBFS		1.7	50	SN 502	0	0	5	7	9	12	17	34	48	70	81	101	118	137	156	166	189	218	242	266
20MPa																								
75% TYPE10	6.5	2.4	50	CONTROL	58	87	125	135	152	168	243	277	293	318										
25% FLY ASH C		1.9	50	DRKGUARD	3	3	8	12	12	17	25	42	55	75	92	122	142	172	190	210	237	263	292	308
20MPa																								
75% TYPE10	6.8	1.4	50	CONTROL	33	67	114	126	127	153	181	210	227	257										
25% FLY ASH C		1.3	50	SN 502	3	3	8	14	14	15	20	25	42	59	76	86	93	110	127	147	167	202	224	240
		-	0	CONTROL	26	106	114	154	170	302	330	362	402	418										
20MPa	6.6	.083	7	DEKGUARD	8	11	21	42	53	90	142	418	590	792										
100% TYPE10		.082	7	SN 502	10	16	46	64	82	115	230	619	846	1024										
20MPa																								
75% TYPE10	6.6	-	0	CONTROL	528	724	768	819	904	957	1050	1099	1126	1154										
25% GGBFS		.364	4	SN 502	17	26	36	45	68	93	112	136	174	357										

* TESTING TERMINATED DUE TO DYKE FAILURE